DOCUMENT RESUME

ED 182 729 CS 005 291

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TITLE Sensitivity to Developmental Differences in Children's Recall of Prose: A Comparison of Two Prose Grammars.
PUB DATE Apr 80
NOTE 19p.: Paper presented at the Annual Meeting of the American Educational Research Association (Boston, MA, April 7-11, 1980)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Development: Comparative Analysis: Content Reading: Developmental Stages: *Discourse Analysis: Elementary Education: Intermediate Grades: *Models: *Organization: Prose: Reading Ability: *Reading Comprehension: Reading Processes: Reading Research: *Recall (Psychological): Retention: Structural Analysis
IDENTIFIERS *Story Grammar

ABSTRACT

Two text-based prose grammars, the W. Kintsch and B. J. F. Meyer models, were compared as to their sensitivity to potential developmental differences in children's recall of prose. Participants in the study were 212 fourth, fifth, and sixth grade students who had been classified as average or below average in reading ability. The Meyer analysis revealed that older good readers showed significantly higher recall of certain idea units than either younger good readers or poor readers of any age. This analysis suggests that older good readers are better able to recall certain implicit semantic relationships than their younger or less skilled counterparts. The analysis using the Kintsch model did not reveal any apparent developmental differences. It was suggested that the Meyer model, because it explicitly describes the "macrostructure" of a passage, is more sensitive to developmental differences in reading ability. The results offer evidence for qualitative differences in the way children at different levels of cognitive development comprehend and recall prose. (Author/RL)

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Sensitivity to Developmental Differences in Children's Recall of Prose: A Comparison of Two Prose Grammars

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Sensitivity to Developmental Differences in Recall of Prose: A Comparison of Two Prose Grammars.

The past few years have seen a proliferation of models for the analysis of the semantic content of discourse (e.g. Frederiksen, 1975; Kintsch, 1974; Mandler and Johnson, 1977; Meyer, 1975; Thorndyke, 1977). These models have typically emphasized either: (a) the role of prior knowledge in affecting comprehension and memory (schema-based); or, (b) the properties of the prose passage itself in affecting comprehension and memory (text-based). The purpose of the research project, of which the present study was a part, was to examine the effects on the learner of the structural organization of learning materials. Therefore consideration of models for comparison was limited to those which addressed the role and properties of the passage itself as a stimulus.

Most of these text-based prose analysis procedures attempt to reduce the lexical form of a prose passage into an ordered list of elements which represents the meaning of what the author of the passage intended to convey; and, which can be used as a basis for comparison to what a reader comprehended and/or recalled. In order for such a grammar to be generally useful as a model of prose comprehension and/or memory it should meet several criteria, among them: parsimony, that is, it should be capable of generating all of the possible semantic relationships found in prose using as few rules as possible; objectivity, that is, it should be capable of being applied according to certain explicit standards, and should not be

overly dependent on the judgement of the user; and, sensitivity, that is, it should be capable of detecting systematic differences in comprehension and/or recall which might exist among different groups of readers.

In the study reported here, two prose analysis models (Kintsch, 1974; and Meyer, 1975) were compared in regard to their sensitivity to potential developmental differences in children's recall for prose. These two models were chosen because it was felt that each was representative of a different approach to text-based discourse analysis. The Kintsch (1974) model is an example of prose "micro-structure" analysis, that is, the focus is upon the semantic relationships within an idea unit while the overall organization of the prose passage is not fully examined. The Meyer (1975) model, on the other hand, is an example of prose "macro-structure" analysis (van Dijk, 1977) which attempts to describe those semantic relationships between idea units which are responsible for a passages's overall organization.

The product of analysis using the Kintsch (1974) method is an ordered list of propositions called the "text base" (see Figure 1).

Insert Figure 1 about here.

The product of analysis using the Meyer (1975) model is a hierarchy of semantically related idea units called the "content

structure" (see Figure 2).

Insert Figure 2 about here.

Both the Kintsch and Meyer models seem to provide similar procedures for the analysis of textual material in that they both describe interpropositional relationships in terms of a hierarchical structure. There are, however, distinct differences between these models. The Kintsch model provides a clear and precise method for representing small individual semantic elements of a passage (i.e. the micro-structure). The interrelationships among these elements, which describe the passage's overall organization, are not clearly represented. The only framework which organizes textual elements in the Kintsch model is the hierarchy itself, which is merely a loose arrangement of propositions. The connecting device among propositions is the repetition of some arguments, and the model does not represent the semantic relationships among propositions in the text-base, unless those relationships are stated explicitly.

The Meyer model, on the other hand, clearly represents the implicit, as well as the explicit, relationships among propositions or idea units (i.e. the macro-structure). Therefore, in the Meyer analysis procedure, a passage's overall organization is described by the content structure, which indicates the semantic and logical importance of each element and the relationship among idea units.

Our question in this study was which of the two models is most capable of identifying potential differences in recall among average and below average readers of different ages. There is ample evidence to indicate that there are differences in recall of linguistic material at various stages of cognitive development (Brown, 1975a, 1975b; Mathews, 1976; Paris, 1975; Paris & Lindauer, 1976). We proposed to compare the Kintsch and Meyer prose analysis procedures in regard to their ability to identify specific recall differences among subjects at various stages of cognitive development.

Method

Subjects

Participants were 212 fourth, fifth, and sixth grade students enrolled in a public elementary school, who had been classified as average or below average in reading ability on the basis of teacher evaluation and subsequent reading group placement. Post hoc classification for confirmation of original designation and additional analyses was made on the basis of California Achievement Test (CTB/McGraw-Hill, 1970) scores.

Material

Two prose passages of different length were adapted from material contained in third grade textbooks. The short passage, called "Greeks", was a 165 word expository text which discussed various factors affecting the development of the ancient Greek and Roman

civilizations. The long passage, called "Pollution", was a 222 word expository text discussing various causes of water pollution.

The two passages were analyzed using both the Kintsch and Meyer procedures.

Procedure

Data were collected during students' regularly scheduled reading classes. Each student was given a packet of papers which had been prearranged in a particular order. The first page was an information page, with the next two pages containing identical copies of the same passage, and the fourth being a blank recall sheet for that passage. The remaining pages consisted of an identical arrangement for the other passage. The order of passage presentation was randomly assigned.

Subjects were informed prior to the experimental task that they would be tested for recall. After reading the first passage twice, students wrote as much of the passage as they could recall, in any order they wished, on the blank sheet of paper. They were given as much time as required and were told to use words that they recalled from the text or their own words. They were instructed further not to worry about correctness of spelling. After recalling the first passage the procedure was repeated for the second passage. Subjects also recorded on the information sheet the time that they spent reading each passage.

Recall protocols of the Greeks and Pollution passages were scored for the presence or absence of each idea unit according to both the

Kintsch (1974) and Meyer (1975) procedures. Because the number of items were not equal at all levels, individual scores were transformed into a proportion of items recalled at each level of the hierarchical representation for each passage. Scoring was done by two judges who had agreed on the criteria for scoring such anamolies as paraphrases, synonymns, and partial idea units. A 20 percent random sample of the protocols were scored by both judges and compared for interrater reliability (see Table 1).

Insert Table 1 about here.

Results

The proportional recall from each of the two passages was analyzed separately using a four factor (grade, reading ability, sex, and level in the hierarchical structure) mixed analysis of variance, with level treated as a repeated measure. Rather than treating passage as a repeated measure, the data for each passage were analyzed separately because of the different number of levels in each hierarchical structure. For the same reason the ANOVA was conducted separately for the Kintsch and Meyer scored data.

The analysis of the Pollution data using both the Kintsch and Meyer models showed significant main effects for grade (Meyer, $p<.001$;

Kintsch, $p=.017$), reading ability (both models, $p<.001$), and level in the hierarchy (both models, $p<.001$) with sixth graders recalling more than fifth graders, and fifth graders recalling more than fourth graders. Similarly, average readers recalled more than below average readers; and, items appearing lower in the hierarchies were generally not recalled as well as higher appearing items, with notable exceptions. The Meyer analysis revealed significant two-way interactions; level x reading ability ($p=.050$), and level x grade ($p=.042$). These two-way interactions seem to be embedded in the three-way interaction, level x grade x reading ability ($p=.018$). A graphical representation of this interaction is shown in Figure 3. The Kintsch analysis did not reveal any similar significant interactions.

Insert Figure 3 about here.

From Figure 3 it appears that the recall pattern of below average readers at all grades, as well as fourth grade average readers, is about the same (i.e. generally descending across levels of the hierarchy). Fifth and sixth grade average readers, however, show a distinctly different recall pattern, with a noticeable increase in recall at level 4. The significance of this difference will be discussed later.

Data from the Pollution passage was also analyzed by combining

students of all ages/grades and reading ability, and then categorizing them on the basis of California Achievement Test (CAT) scores. Subjects were identified as high (CAT = 60-72), medium (CAT = 40-59), or low (CAT = 20-39). A three-factor ANOVA (CAT group x sex x level in the hierarchy) was performed separately for the Meyer and Kintsch scored data from each passage. This analysis revealed main effects for CAT group and level in the hierarchy for both the Pollution recalls scored according to both models (higher CAT groups recalling more than lower CAT groups, $p<.001$; and upper level items recalled generally better than lower level items, $p<.001$). The analysis of the Meyer scored data also indicated an interaction between CAT group and level in the hierarchy ($p<.001$). This pattern, shown in Figure 4 is quite similar to that seen in the prior analysis shown in Figure 3. This analysis of the Kintsch scored Pollution data failed to show any significant pattern differences.

Insert Figure 4 about here.

Analyses of the Greeks passage indicated significant main effects for grade, reading ability, and level in the hierarchy for data scored by both models. Neither the Meyer nor the Kintsch scored data revealed any significant interactions among factors like those that were evident in the Pollution passage. A three-factor ANOVA (CAT group x sex x level) was done separately for the Meyer and Kintsch

scored data, and showed main effects for CAT group and level similar to those found in all previous analyses. The only interaction that approached conventionally accepted levels of significance was a two-way interaction (CAT group x level in the hierarchy, $p=.070$) for the Meyer scored data. The pattern of this marginal interaction is shown in Figure 5. As was the case with all previous analyses, the Kintsch scored data revealed no such interactions that approached significance.

Insert Figure 5 about here.

Finally, Pearson Product-Moment Correlations were performed to determine whether or not there was a significant correlation between reading time and the proportion of total idea units recalled from each passage. For the Greeks passage, $r(212) = 0.072$, $p>.10$; and for the Pollution passage, $r(212) = -0.043$, $p>.10$. These results indicate that there was no significant correlation between recall and reading time for either passage.

Discussion

The purpose of this study was to compare the Kintsch (1974) and Meyer (1975) models of prose analysis in regard to their sensitivity in detecting potential differences in the patterns of recall of

subjects at different levels of cognitive development. The Meyer analysis, by revealing the interactive effects of grade, reading ability, and level in the hierarchy, seems to be more sensitive in this regard than does the Kintsch model.

The Meyer model, because it describes the interrelationships of all idea units more fully than does the Kintsch model, identifies and describes more accurately the types of inferences that a skilled reader appears to make, and a less skilled or younger reader fails to make, when reading ani recalling a passage. Although the Kintsch grammar indicates interpropositional relationships, it does so only insofar as they are signalled by explicit reference or by repetition of an argument in subsequent propositions. If one of the differences between good and poor readers is the ability to infer implied relationships, the Kintsch analysis fails primarily because it does not provide an adequate means for representing those implied relationships. The Meyer model, since it counts the implicit relationship as an idea unit, readily differentiates in its scoring system among subjects differing in their ability to infer certain implicit relations.

If the detection and subsequent recall of these implied relationships is responsible for the interaction at level 4 of the Pollution passage and levels 4 and 6 of the Greeks passage, one would expect that there would be a higher concentration of implicit relationships at these levels. This is in fact the case. Level 4 of the Pollution passage is heavily loaded with implicit idea units (namely; collections, and specifications), and levels 4 and 6 of the

Greeks passage are disproportionately high in the number of implicit cause and effect relationships. Post hoc examination of a sample of subject recalls shows that older good readers recalled a higher ratio of these items than did the younger and/or below average readers.

The comparative use of both models also resulted in several additional observations. (1) The method by which level in the hierarchy is determined according to the Kintsch model seems somewhat unrealistic. Repetition of an idea automatically subordinates it in the hierarchy, even though later appearing propositions might be logically more important. In contrast, because the Meyer model identifies relationships among idea units, it places logically important ideas at the higher levels of the content structure. (2) The Kintsch analysis procedure, from a user's perspective, is less arbitrary and is more objectively applicable than the Meyer procedure. A proposition is a more discretely defined entity than is the somewhat ambiguous "idea unit". This discreteness makes analysis and scoring much easier.

In conclusion, the present study adds to a growing body of evidence regarding the explanatory and predictive adequacy of prose analysis models. The Meyer model, because of its apparent sensitivity to developmental differences in recall, was found to be a more descriptive and predictive tool. Level in the hierarchy was found to affect the "memorability" of an idea unit, but was not the sole factor since level interacted with subjects' level of cognitive development to affect recall.

Future research may find that prose analysis models such as those

examined here may be beneficial in examining the organizational processes involved in the storage and recall of information presented textually. As such, these models may provide additional insight into the cognitive processes involved in reading.

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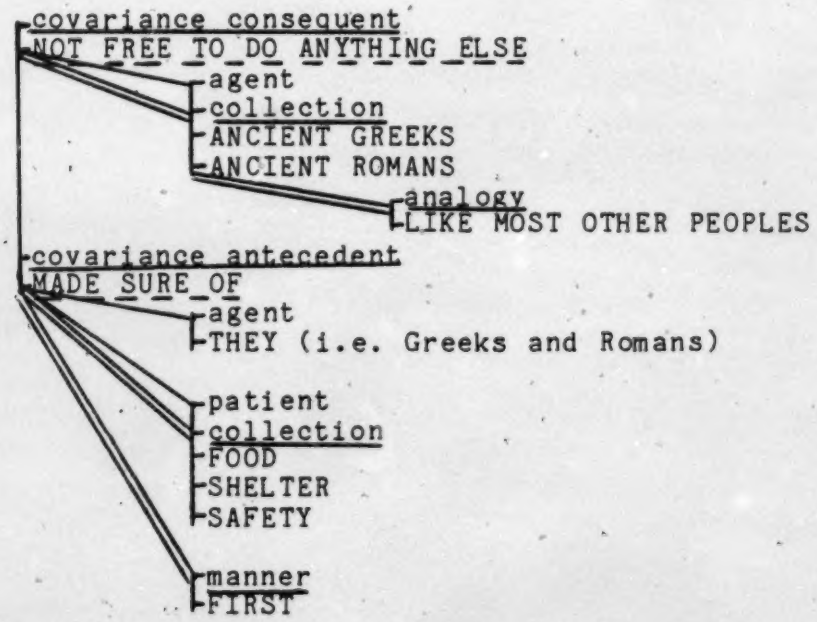
Text Base:

(1) (LOVE, Agent: GREEK, Object: ART)
(2) (Qualify, ART, BEAUTIFUL)
(3) (CONQUER, Agent: ROMAN, Experiencer: GREEK)
(4) (COPY, Agent: ROMAN, Experiencer: GREEK)
(5) (Time: WHEN, (3), (4))
(6) (LEARN, Agent: ROMAN, (8))
(7) (Consequence, (3), (6))
(8) (CREATE, Agent: ROMAN, (2))

Text: The Greeks loved beautiful art. When the Romans conquered the Greeks, they copied them, and thus, learned to create beautiful art.

Figure 1. An example of a text base and accompanying text generated by the Kintsch model. (Indentation to the right indicates subordination. Numbers within a proposition signify that the proposition corresponding to that number is being used as an argument.)



Text: The ancient Greeks and ancient Romans, like most other peoples, were not free to do anything else, until they first made sure of food, shelter, and safety.

Figure 2. An example of a content structure and accompanying text generated by the Meyer model. (Indentation to the right indicates subordination.)

Table 1

Interrater agreement on protocol scoring

Passage	Meyer Analysis	Kintsch Analysis
Greeks	90.6%	96.3%
Pollution	92.0%	97.1%

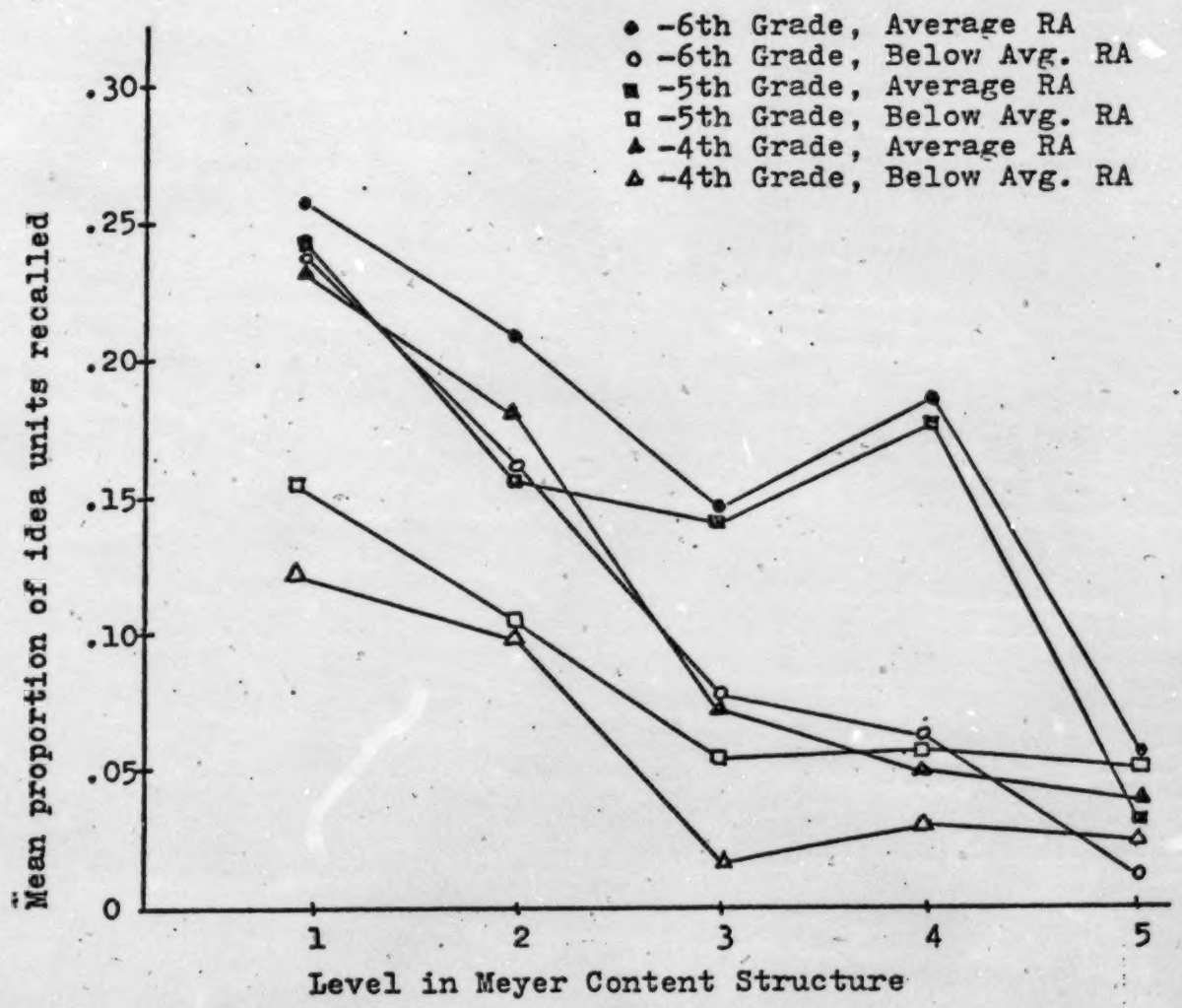


Figure 3. Mean proportion of idea units recalled from Pollution passage, by grade and reading ability, across levels of Meyer content structure.

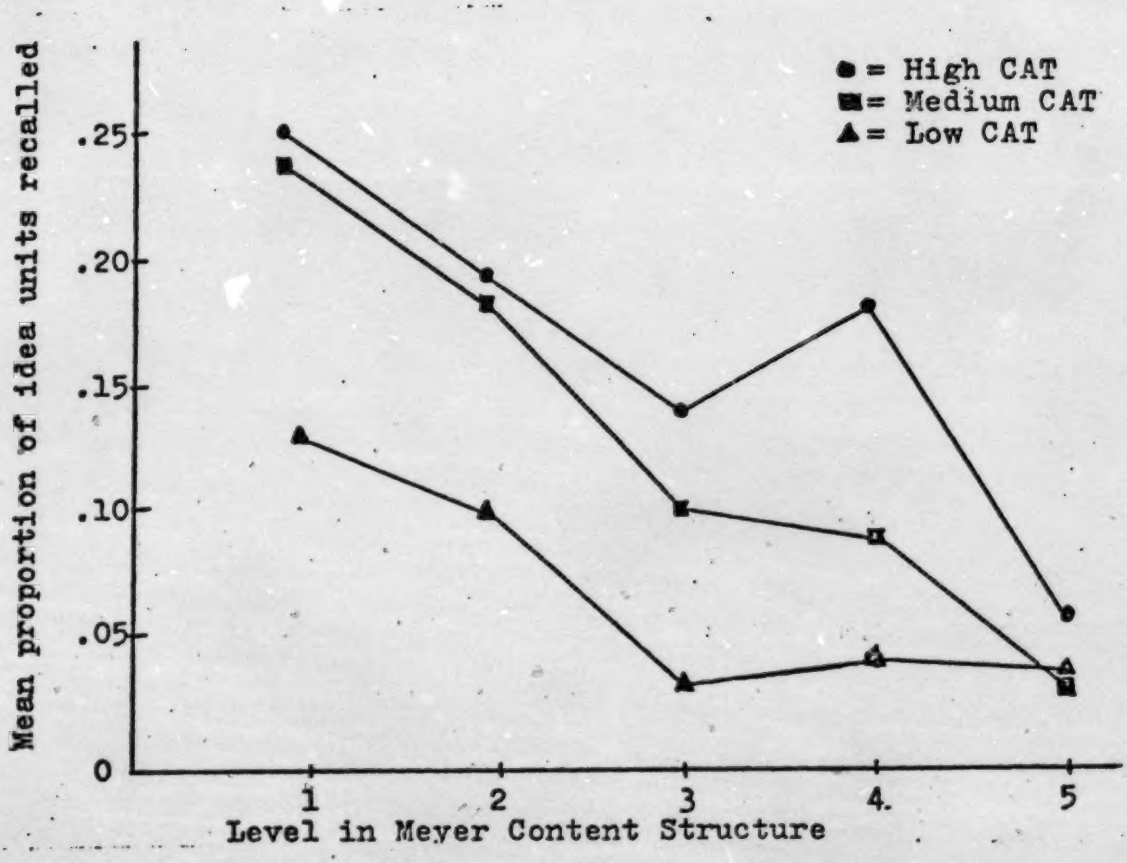


Figure 4 Mean proportion of idea units recalled from "Pollution" passage, by CAT score, across levels of Meyer content structure.

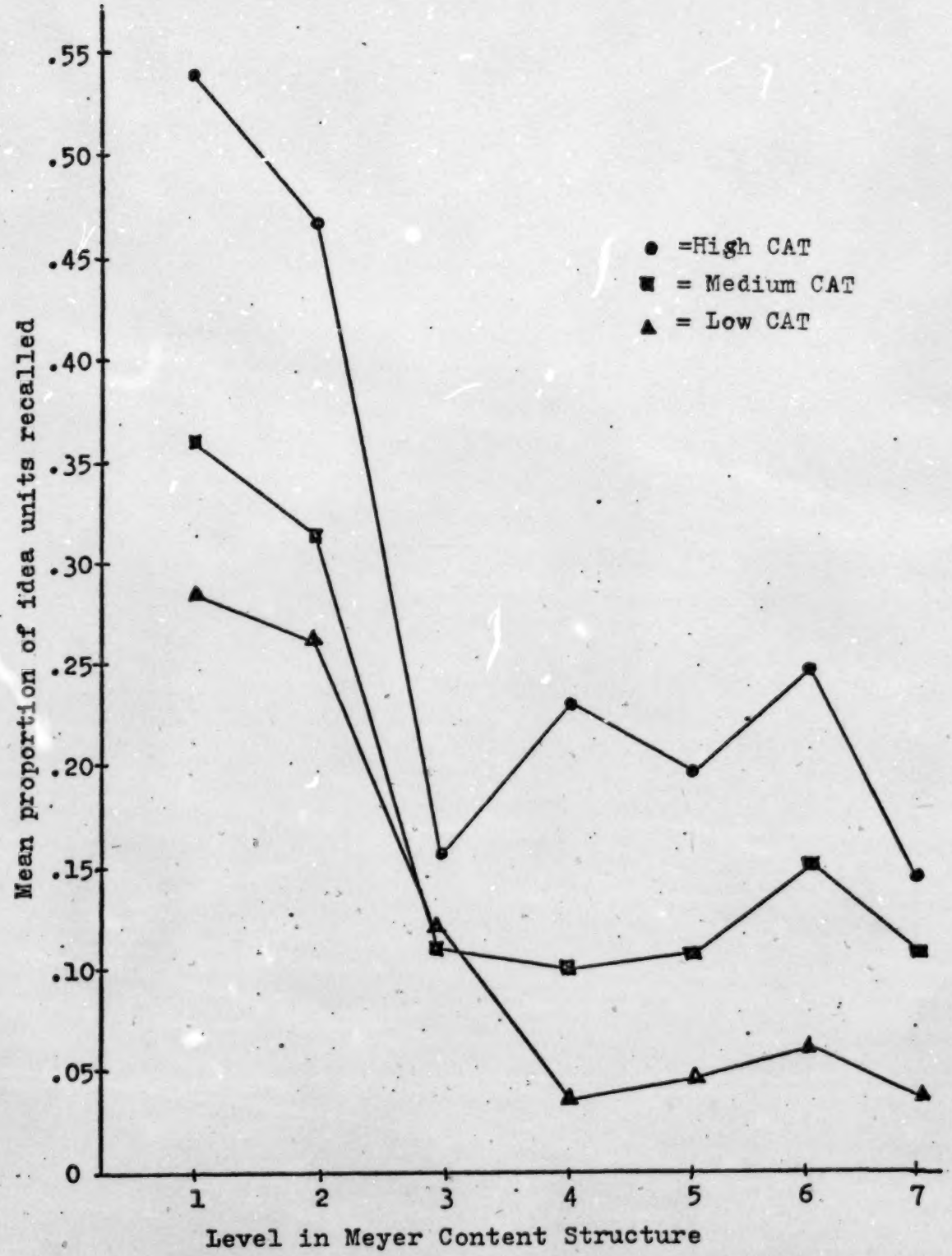


Figure 5. Mean proportion of idea units recalled from Greeks by CAT score across levels of Meyer content structure.